



# Course Specification

## **DIPLOMA**

**Course Title:** Thermodynamics

**Course Code:** APRT1201

**Program:** Renewable energy technologies

**Department:** Diploma Department

**College:** The Applied College

**Institution:** Umm Al-Qura University

**Version:** 1

**Last Revision Date:** 10 February 2025



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## A. General information about the course:

### 1. Course Identification

1. Credit hours: (2)

2. Course type

A. ☐ University ☐ College ☒ Department ☐ Track ☐ Others  
B. ☒ Required ☐ Elective

3. Level/year at which this course is offered: ( 1<sup>st</sup> Level / 1<sup>st</sup> year)

4. Course General Description:

#### 1. Course Description

This course introduces the basic concepts of Thermodynamics to undergraduate students. The energy heat and work relations are first explained in the context of the first law of thermodynamics. Further the definitions of systems, energy forms and types, properties, process, and cycle are discussed. The 1st law applications on open and closed systems are covered. The students also learn the properties of pure substances, P-V-T relations of ideal gases and phase change. The usefulness and application of the 2<sup>nd</sup> law is presented followed by further discussion and introduction of entropy and irreversibilities quantifications.

5. Pre-requirements for this course (if any):

6. Co-requisites for this course (if any):

7. Course Main Objective(s):

#### Course Main Objective

To help students identify definitions and terms associated with thermodynamic concepts and explain them. Define the various forms of energy, energy conversion efficiency and relation to the environment. Apply the first law and write the energy balances on open and closed systems. Identify a pure substance and explain its phase changes using p-v and T-s diagrams. Apply ideal gas equation. To apply first law on closed system. To determine changes in internal energies of systems. To define and discuss the second law of thermodynamics. Use second law to identify valid and invalid processes.

2. Teaching mode (mark all that apply)

| No | Mode of Instruction   | Contact Hours | Percentage |
|----|-----------------------|---------------|------------|
| 1  | Traditional classroom | 2             | 100%       |
| 2  | E-learning            |               |            |





| No | Mode of Instruction  | Contact Hours | Percentage |
|----|--|---------------|------------|
| 3  | Hybrid <ul style="list-style-type: none"> <li>Traditional classroom</li> <li>E-learning</li> </ul> |               |            |
| 4  | Distance learning  |               |            |

### 3. Contact Hours (based on the academic semester)

| No    | Activity          | Contact Hours |
|-------|-------------------|---------------|
| 1.    | Lectures          | 30            |
| 2.    | Laboratory/Studio |               |
| 3.    | Field             |               |
| 4.    | Tutorial          |               |
| 5.    | Others (specify)  |               |
| Total |                   | 30            |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes  | Code of PLOs aligned with the program | Teaching Strategies                                   | Assessment Methods                  |
|------|---|---------------------------------------|---|-------------------------------------|
| 1.0  | Knowledge and understanding   |                                       |   |                                     |
| 1.1  | Define first and second laws of thermodynamics, intensive and extensive properties, a cycle, a process, work, and heat. | K1                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes, Midterm and Exam |
| 1.2  | List forms of energy with examples.   | K2                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes, Midterm and Exam |
| 1.3  | Differentiate between closed and open systems, heat and   | K3                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes,                  |





| Code       | Course Learning Outcomes   | Code of PLOs aligned with the program | Teaching Strategies                                   | Assessment Methods                  |
|------------|--|---------------------------------------|---|-------------------------------------|
|            | work, energy input and energy output.  |                                       |   | Midterm and Exam                    |
| 1.4        | Derive the energy efficiency/Coefficient of Performance (COP) for different systems. | K4                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes, Midterm and Exam |
| <b>2.0</b> | <b>Skills</b>  |                                       |   |                                     |
| 2.1        | Determine the total change of energy of a system using property tables.              | S1                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes, Midterm and Exam |
| 2.2        | Conduct energy analysis of components to determine efficiency                        | S2                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes, Midterm and Exam |
| 2.3        | Communicate effectively through final project report and assignments                 | S3                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes, Midterm and Exam |
| <b>3.0</b> | <b>Values, autonomy, and responsibility</b>  |                                       |   |                                     |
| 3.1        | Function as an effective part of a teamwork.   | V3                                    | Lectures, tutorials and independent study assignments | Homework, Quizzes, Midterm and Exam |



## C. Course Content

| No    | List of Topics                                       | Contact Hours |
|-------|--|---------------|
| 1. 1  | Introduction   | 3             |
| 2. 2  | Basic Concepts of Thermodynamics.                    | 3             |
| 3     | Energy, Energy Transfer and General Energy Analysis. | 6             |
| 4     | Energy Analysis of Closed Systems.                   | 6             |
| 5     | Mass and Energy Analysis of Control Volume.          | 6             |
| 6     | The Second Law of Thermodynamics.                    | 3             |
| 7     | Entropy.   | 3             |
| Total |  | 30            |

## D. Students Assessment Activities

| No   | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|------|-------------------------|--------------------------------|--------------------------------------|
| 1. 1 | Quizzes and Exercise    | 3-8                            | %10                                  |
| 2. 2 | Report & Presentation   | 3-8                            | %20                                  |
| 3. 3 | Mid-term                | 9                              | %20                                  |
| 4    | Final exam              | 17/18                          | 50%                                  |

\*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

|                          |  |
|--------------------------|--|
| Essential References     | Thermodynamics: An Engineering Approach ( 8 th ed. 2014 ). By Yunus A. Cengel , D., and M.A. Boles. McGraw Hill Education.   |
| Supportive References    | Property Tables.   |
| Electronic Materials     | <ul style="list-style-type: none"> <li>Engineering Equation Solver (EES) software package.</li> <li>Educational videos.</li> </ul>   |
| Other Learning Materials | <ul style="list-style-type: none"> <li>Fundamentals of Engineering Thermodynamics (7<sup>th</sup> ed. 2011). By Moran, M.J., and H.N. Shapiro, John Wiley &amp; Sons.</li> <li>Applied Thermodynamics for Engineering Technologists (5<sup>th</sup> ed. 2011). By Eastop, T.D., and A. McConkey. Pearson Education.</li> </ul> |

### 2. Required Facilities and equipment





| Items   | Resources  |
|---|------------|
| <b>facilities</b><br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Classrooms |
| <b>Technology equipment</b><br>(projector, smart board, software)                         | Data show  |
| <b>Other equipment</b><br>(depending on the nature of the specialty)                      |            |

## F. Assessment of Course Quality

| Assessment Areas/Issues                     | Assessor            | Assessment Methods                                 |
|---|---------------------|--|
| Effectiveness of teaching                   | Faculty             | Direct (project, HW, Quiz, midterm and final exam) |
| Effectiveness of Students assessment        | Students            | Indirect (Student Survey)                          |
| Quality of learning resources               | Program Coordinator | Direct analysis                                    |
| The extent to which CLOs have been achieved | Program Coordinator | Direct analysis                                    |
| Other                                       |                     |  |

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

|                           |                                |
|---------------------------|--------------------------------|
| <b>COUNCIL /COMMITTEE</b> | Umm Al-Qura University Council |
| <b>REFERENCE NO.</b>      | 851141114462/190394            |
| <b>DATE</b>               | 22/11/1446                     |

